Research and Assessment

A HMDA-Based Housing Market Index to Track Neighborhood Change[1]

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To stabilize foreclosure-damaged neighborhoods, policymakers must take a series of decisions on where and how to deploy scarce financial and technical resources: Which neighborhoods would benefit most from concentrated investments? Should investments be used to acquire and hold properties, to sell them quickly, or to demolish them? Should foreclosed owner or investor-owned housing be given priority? How much subsidy is appropriate to spend for each unit of housing? What other kinds of investments – in foreclosure prevention or public safety – could best complement property purchases?

Nearly all of these decisions require some knowledge of the neighborhood market and educated guesses about which direction that market will head when the glut of foreclosures has passed.

In some cities and metropolitan areas, a very large percentage of low-income neighborhoods have been hard hit by foreclosures caused by subprime loans, falling prices, and rising unemployment. But however damaged in the short-run, some of these neighborhoods have reasonably strong long-term prospects. Reclaiming vacant properties in these areas will require different types of policies, strategies, and levels of investment than will properties in neighborhoods that are chronically weak. Moreover, even weak market neighborhoods differ from one another in ways that are important to eventual response; e.g., in the number and types of rental housing.

Indeed, policymakers and researchers generally agree that the most effective approaches to neighborhood stabilization are those keyed to market conditions. But despite this agreement, there are few tools available to do this kind of market diagnosis.

To help remedy this deficit, LISC researchers have constructed a prototype index of market strength. This index holds considerable promise as a single and transparent market indicator that draws on Home Mortgage Disclosure

[1] Please note that the LISC Housing Market Index is newly developed and cannot be tested until it gets into circulation. We have made it publicly available both to encourage comments and to assist communities engaged in neighborhood stabilization planning. We invite people to read this paper and send comments to cwalker@lisc.org or feedback@housingpolicy.org. We also invite people to send comments on how well the index seems to work in their on-the-ground applications. We plan to test and improve the index and release revisions as warranted and updated data periodically.

Act (HMDA) data, which are readily-obtainable and available at the neighborhood level. The index is comprised of separate indicators of mortgage transaction velocity for owner-occupants and investors, the percent of purchases by owners, the percentage of high cost loans, and median value of all neighborhoods' mortgages relative to those in all low-income neighborhoods area-wide.

SECTION 1: DESCRIPTION OF THE INDEX

Introduction

The purpose of this analysis is to create an index of neighborhood housing market strength that is valid, reliable, easy to construct, and easy to use.

Neighborhood housing market strength refers to attributes of the housing market that reflect the relative quality of neighborhoods as perceived in the marketplace. These include relatively high housing values, an active market for investor and owner-occupied purchases, investments in the renovation or upgrade of the housing stock, and reasonable rates of return from owner-occupied and rental housing.

These attributes can rarely be measured directly, and when they are, it is usually for a small sample of properties or locations and at a single point in time. Researchers and policymakers interested in tracking neighborhood housing markets, therefore, most often must rely on either partial measures (covering some attributes rather than others) or on proxy indicators based on data sources that are more readily available. For ease of comparison, it is also useful to bundle multiple indicators into an index that can be expressed as a single number. This allows quick comparisons across many neighborhoods in a metropolitan area, and to do so over time.[2]

In the past, researchers have used data available from reports filed under the Home Mortgage Disclosure Act (HMDA) and the US Census, which are the only two sources of publically-available neighborhood-level information available on the housing market. This analysis draws on this same source to construct our Housing Market Index.

To be useful, the index should satisfy all of the following criteria:

- Validity: the indicators used in the construction of the index should be valid proxies for the housing market phenomena that we cannot measure directly.
- Reliability: the indicators and the resulting index should work reasonably well across different metropolitan areas and across time.
- Ease of construction: data should be easy to obtain, indicators should be relatively few, the weighting, if any, should be uncomplicated, and the index should be easy to explain.

[2] For the purposes of this paper, metropolitan areas are delineated by their 1999 definitions.

To construct an index that satisfied these three criteria, we carried out three basic analyses. First, to identify the variables to be used in the index and arrive at reasonable weights for index calculation, we ran statistical models to predict several measures of market performance at the ZIP code level. This was done to allow us to test the index against loan foreclosure rates – a strong housing market performance measure -- which are available to the analysis only at the ZIP code level. Second, we analyzed the behavior of the resulting index at the city level using data on price change, foreclosure rates, and other performance measures from selected cities where these data were available. Third, we examined the relationship between the housing market index and changes in the index and indicators of racial-ethnic transition in housing markets for all metropolitan area low- and moderate-income census tracts in the United States. After a description of the index itself, these tests will be described in the sections to follow.

Index Description

The Housing Market Index value for any neighborhood is the sum of its weighted, standardized, scores on five variables, as summarized in the chart below. These variables are drawn from data available from HMDA and the US Census and thus are readily available and cheap to acquire. They are standardized so as to reflect any neighborhood's value relative to other neighborhoods within the same metropolitan area. The weights are based on variables' relative importance as predictors to other measures of market strength.

Name	Definition	Weight
VALUE	Median value of first lien home purchase mortgages	.6
HIGHCOST	Percent of all first lien mortgages that are high-cost	.4
OWNVELOC	Velocity of home purchase mortgages transactions to owner-occupants, measured as the number of first-lien owner-occupant mortgages / the number of owner-occupied units in 2000	.3
INVESTVELOC	Velocity of home purchase mortgage transactions to investors, measured as the number of first lien investor mortgages / the number of single-family rental units in 2000	.1
OWNERPCT	The percentage of first lien mortgages to owner occupants, measured as the number of owner-occupant mortgages / (owner-occupant mortgages + investor mortgages)	.2

The Index value is calculated as:

INDEX = .6*VALUE - .4*HIGHCOST + .3*OWNELOC + .1*INVESTVELOC + .2*OWNPCT

The reasoning behind the choice of these variables is noted below:

1. Median value of first-lien home purchase mortgages

Median mortgage values have been shown, and are shown in this paper, to be a good proxy for median home sales prices, which in turn are taken to reflect the relative quality of any given neighborhood relative to other neighborhoods within the same marketplace. This is because housing prices capitalize the attributes of

neighborhood – such as proximity to parks or perceived levels of safety – which are simultaneously attributes of the housing units people occupy.

2. Percent of all first lien mortgages that are high-cost

A proxy for sub-prime lending, "high-cost" lending as defined in HMDA has been shown to be closely tied to subsequent foreclosure and vacancy problems in neighborhoods where high-cost loans are concentrated. This indicator is weighted negatively in the index calculation; i.e., the higher the percentage of high-cost loans, the lower the index score, all else equal.

3. Velocity of home purchase mortgages transactions to owner-occupants

The volume of home purchase mortgages is taken to be a proxy for the volume of home sales, an assumption supported by the analysis described in this paper. All things equal (and in particular, for any given level of high-cost lending, which may have fueled higher volumes) a larger number of mortgages relative to the number of owner-occupied units is treated as a sign of market strength relative to neighborhoods where lending is sparse.

4. Velocity of home purchase mortgage transactions to investors

As with the volume of owner-occupied mortgage transactions, more investor transactions are generally taken to be associated with better-functioning housing markets, all things equal (again, especially including the percentage of high-cost loans). In particular, neighborhoods with large numbers of rental housing typically benefit from an active investor market, although some community developers regard rising investor loan volume as a worrisome sign of neighborhood transition from owner- to rental-occupied housing.

5. The percentage of first lien mortgages to owner occupants, measured as the number of owner-occupant mortgages / (owner-occupant mortgages + investor mortgages)

Many community developers aim to build homeownership rates in lower-income neighborhoods as a way to achieve a diversity of income levels in neighborhoods and increase the complement of residents who have a strong stake in the strength of neighborhood institutions, the level of social organization, and the quality of urban services, like retail opportunities and public service delivery. Higher percentages of loans to owners, as opposed to investors, are taken to be indicative of a neighborhood's successful appeal to homebuyers.

To construct the Housing Market Index, each of these variables must be translated into a common unit so they can be entered into the equation, above. As it stands, each of these variables is measured using different units, for example, dollars for mortgage values and percentages for high-cost loans. **Table 1** shows the mean values for each variable for each year for all low- and moderate-income tracts. (**Appendix Tables 1 and 2** show a more complete set of statistics, including comparison of values of low- and moderate-income tracts to non-low-mod tracts.) Note that each year's data consist of two-year averages; we did this to accommodate tracts with a relatively few mortgage transactions, which can produce wide year-to-year swings in variable values.

Table 1
Mean and Median Values for Housing Market Index Components

Component		Two-Year Average 2004/5	2005/6	2006/7	2007/8
Number Owner-Occupant First-Lien Home Purchase Mortgages / Owner-Occupied Units, 2000	Mean	9.5%	10.4%	8.9%	6.3%
	Median	6.0%	5.9%	4.8%	3.2%
Number Investor First-Lien Home Purchase Mortgages / Single-Family Rental Units, 2000	Mean	4.9%	5.2%	4.2%	2.7%
	Median	2.3%	2.4%	1.8%	1.2%
Percent of First Lien Home Purchase Mortages to Owner Occupants	Mean	75.5%	75.4%	76.9%	77.6%
	Median	79.6%	79.4%	80.8%	81.5%
Median Mortgage Value	Mean	$154,450	$171,946	$180,061	$170,253
	Median	$114,500	$127,000	$136,500	$134,500
Percent of First Lien Home Purchase Mortgages That are High-Cost	Mean	30.6%	39.7%	35.4%	24.0%
	Median	28.6%	38.8%	33.3%	20.8%

It is important to note that the values of the index components are not highly inter-correlated with one another. Practically speaking, this means that we are using variables that measure independent phenomena. For example, the highest correlation coefficient between15 possible bivariate pairings for 2007/8 is -.353 (between the percent of high-cost loans and mortgage value); all of the remaining 14 pairings are below .200. (An interesting side note, the velocity of owner-occupant and investor mortgage transactions is completely unrelated to the relative value of mortgages; the full set of bivariates can be found in **Appendix Table 3**.)

To convert these variables to common units, and following common practice, we standardized variables through a *z-score transformation*, in which the value of any variable for a given unit of geography is assigned a score based on the mean and standard deviation of that same variable across all low- and moderate-income census tracts in the metropolitan area. Because the Housing Market Index is intended for local use, the constituent elements of the index are measured, for each neighborhood, based on that neighborhood's relative position within the metropolitan area of which it is a part. That is, neighborhoods are compared only to other neighborhoods within the same metropolitan area.

This z-score transformation produces a score for each variable that has a mean of 0 and a standard deviation of 1. For testing purposes, we created two versions of the score: one for all metropolitan area census tracts and one for low- and moderate-income tracts only. The z-score distributions for each index component in 2007/8 are shown in **Appendix Table 4A**. The components were weighted, then added to one another, to produce a single index value. **Appendix Table 4B** shows the distribution of the resulting scores in each year for the all-tract and low-mod-tract versions of the indexes.

Finally, we examined the year-to-year stability of the index by correlating each year's index value to the values of the other years. If index values changed dramatically from year to year, we would suspect either the weighting we adopted, the validity of the measures of each index component, or both**.** **Appendix Table 5** shows the results

of this analysis: adjacent-year bivariate comparisons for the low-mod version of the index produce correlation coefficients that range from .903 to .921; i.e., at the higher end, any year's score predicts about 85 percent of the variance in the subsequent year's score. (Of course, one reason for this stability is built into the index construction, which uses overlapping two year averages.) Comparing the endpoints of the analysis period – 2004/5 and 2007/8 –produces a correlation coefficient of .771 (59 percent of the variance explained); i.e., over a three year period, there is a modest amount of shift in the relative position of low-mod tracts within metropolitan areas.

As a concluding note, several points are worth making about the index components and their weighting:

- The measure places great weight on relative mortgage values, which has the strongest theoretical justification among all of the variables used. This does not mean that rising mortgage values (signaling rising prices) are welcome in all neighborhoods – simply that rising values are associated with strengthening markets, regardless of how the benefits of this trend are distributed among different types of owners and renters.

- The measure places considerable weight on the percentage of high-cost loans. An impressive body of previous analysis has shown how damaging these loans have been to the households who used them and the neighborhoods where they are concentrated. It is certain that with changes in the mortgage market in recent years, this variable will become less important as time goes on, and may need to be re-weighted, or even dropped altogether, based on findings from the most recent release of 2009 HMDA data and future years' releases.

- Except for the ratio of owner-occupant to investor loans, the value of the index itself does not skew strongly toward places that are dominated either toward the owner-occupied or renter-occupied stock. Velocity for owner-occupants is calculated relative to baseline owner-occupancy levels; velocity for investors is relative to the single-family rental stock, the types of investor-owned units most likely to be reported in HMDA.

SECTION 2: DEVELOPING AND TESTING THE INDEX

To arrive at the variables and weights used to construct the index described above, we carried out a series of steps:

First, we constructed a set of regression models that use HMDA-based variables measured at the ZIP code level to predict housing performance indicators across all metropolitan area ZIP codes, and across ZIP codes within selected metropolitan areas.[3] This ZIP code-level analysis enabled us to use loan delinquency and foreclosure rates as a performance measure. We compared the results across different metropolitan areas and performance measures to arrive at the set of indicators and weights presented in the preceding section.

Second, we examined the relationship between the HMI and its constituent indicators and housing market performance indicators measured at the census tract level for selected cities. This enabled us to include foreclosure, building permits and tax delinquencies in cities where those were available, as well as test the value of the HMI for the relatively small numbers of geographic units (census tracts) that comprise each city. In one city, we asked local housing experts to comment on patterns of HMI values across neighborhoods in light of their intimate knowledge of neighborhood patterns.

Third, we examined the relationship between the HMI and estimated changes in the racial and ethnic composition of neighborhoods, expecting that neighborhoods with relatively high shares of white home purchasers would display higher HMI values and change in HMI values over the 2004/5 to 2007/8 period for which the HMI was calculated.

HMI and Market Performance in Metropolitan Area ZIP Codes

Many indexes treat all constituent indicators equally and simply add scores to produce an overall index value. We used all metropolitan area ZIP codes to develop Housing Market Index alternatives using modeled relationships between Index components and three measures of market "performance." We used three performance indicators:

(1) Standardized change in relative mortgage value over the 2000/1 to 2007/8 period. This measure taps the medium-term (eight-year) relative attractiveness of any ZIP code's housing, assuming that mortgage values proxy home prices.

(2) Standardized change in relative mortgage value between 2006/7 and 2007/8 – the period when home prices declined in most metropolitan areas. Relative performance of any ZIP code in this period is taken to be a measure of price resilience in otherwise adverse conditions.

(3) Standardized percentage of loans in distress, measured as those at least 30-days delinquent or in foreclosure as a percentage of loans outstanding as of December 30, 2008. (The predictive value of index components was higher for delinquency than foreclosure if modeled separately, but both are used in the final tests.) These loan

[3] HMDA data is available at the census tract level and was reweighted to ZIP Code Tabulation Areas using a crosswalk obtained from Geolytics.

distress indicators are based on data from LPS Applied Analytics, corrected for possible undercounts according to the methodology described in the Appendix.

No one single measure of performance useful as test. Loan distress is a strong measure, reflecting both the strength of housing values relative to mortgage loan amounts and the purchasing power of households with mortgages. The Index seems to perform reasonably well across multiple measures.

To test indicator variables and evaluate possible weighting, we included both the point-in-time variables described in the preceding section, as well as other standardized covariates in the model that were related to the indicators under consideration. For the most part, these included both point-in-time variables, such as relative mortgage value, as well as change variables, such as changes in mortgage values over some period. For example, because mortgage value change over the 2000/1 to 2007/8 period is strongly related to baseline mortgage values in 2000/1, the baseline mortgage value was included in two of the models.

It is worth emphasizing that because the index is intended for use as a monitoring tool as neighborhoods change, the index is constructed using only the point-in-time values for each index component so that the index values can be compared from year to year, even though inclusion of change variables increases the predictive power of the models. In other words, change variables – e.g., changes in median mortgage values from some baseline year – are not used in the index.

We weighted the indicators according to their predicted effects of multiple covariates on these selected measures of performance, using the beta weights from the regression models. Weight selection was an iterative process, as beta weights (the change in standard deviation units of the dependent variable produced by a standard deviation change in the independent variables) shifted across performance indicators and metropolitan areas.

Table 2 shows the results of the three models. Several points are worth making.

(1) Different models were run for mortgage value change over the entire period and for end-period mortgage value change and percentage of loans distressed. The actual indicators used, however, are conceptually related to one another.

(2) The indicators that are statistically significant at the .1 level are highlighted in yellow.

(3) The models are not directly comparable because mortgage value change, used as a covariate in the analysis of end-period mortgage value change and distressed loan percentage, is the dependent variable for the first model.

Table 2
Beta Weights from Regression of Three Housing Market Performance Indicators on HMDA Mortgage Indicators
(All Metropolitan Area Zip Codes)

	Market Performance Indicator					
	Mortgage Value Change 00/01 to 07/08		**Mortgage Value Change 06/07 to 07/08**		**Percentage of Loans Distressed 12/08**	
1						
Percent of Loans High Cost-2006/07	-.220	.000	-.098	.000	.651	.000
Owner-Occupied Transaction Velocity-00/01	-.040	.000				
Owner-Occupied Transaction Velocity-06/07			-.060	.000	.037	.091
Investor Transaction Velocity 00/01	.068	.000				
Investor Transaction Velocity 06/07			.001	.930	-.010	.127
Relative Mortgage Value 2000/01	-.269	.000				
Relative Mortgage Value 2007/08			.129	.000	-.203	.000
Change in Loan Value 2004/5 - 2007/8			-.095	.000	.061	.000
Owner-Occupied Percentage 2001/2	.032	.006				
Percent Loans to Owners 2000/1	-.129	.000				
Percent Loans to Owners 2007/8			-.063	.000	.004	.545
Change in Owner-Occupant Percentage of all Mortgages 2000/1 - 2004/5	-.016	.143				
Change in Owner-Occupant Percentage of all Mortgages 2004/5 - 2007/08	.029	.003	.098	.000	.006	.316
Change in Owner-Occupied Transactions 2000/1 - 2007/8	.164	.000	.108	.000	.021	.002
Change in Investor Transactions 2000/1 - 2007/8	-.044	.000	-.031	.004	.027	.000
R-Square	.113		.052		.628	

Five variables turn out to be most important: velocity of owner-occupant and investor purchases, relative mortgage values, percentage of mortgages to owner-occupants and percentage of high-cost loans.

As noted in the preceding section, the first three are driven by strong theoretical foundations: high velocity (and more important for the use of the index of time) the change in velocity should be associated with higher changes in relative prices and a lower percentage of distressed loans. Higher mortgage values (and changes in relative mortgage value) should reflect the price capitalization of relative neighborhood quality. The fourth indicator – percent of loans to owner-occupants – taps the relative attractiveness of the neighborhood to a valued class of buyers. The fifth indicator – the percentage high-cost loans – has been shown in previous analysis to be a strong predictor of loan distress.

Overall, controlling for all of the other indicators and covariates in the model, high-cost loan percentage and relative mortgage value (or change in relative mortgage value) exert the strongest effects on the three performance measures. Change in owner velocity and changes in the percent of loans to owners relative to investors is

associated with changes in mortgage value over the entire period and at the end of the period. All of the signs are in the predicted direction. Change in investor transactions tend not to be associated with performance, and are negative for mortgage value change over the period.

Model 1: Change in Mortgage Value from 2000/1 to 2007/8

We find that mortgage value change is negatively associated with relative values at the beginning of the period and with the percentage of units that are owner-occupied (from Census 2000). That is, we find stronger value growth in ZIP codes where prices and owner-occupancy were lower at the beginning of the period. Further, positive shifts in the velocity of loans to owner-occupant purchasers and increases in the percentage of loans to owner-occupants (for the latter one-half of the entire period) also are associated with increases in mortgage values. Change in investor transaction velocity is negatively associated with value change.

The percentage of high-cost loans in 2006/7, at the height of high-cost lending, is negatively associated with change in relative mortgage values (controlling for all other variables in the model). All things equal, markets most typified by high-cost lending tended to be areas with weaker mortgage value growth.

As should be obvious from the table, however, the predictive value of the model is not strong (an R-square of only 0.113). This is probably because the model is not constructed as a time-series analysis and the use of large and homogenous ZIP codes (relative to census tracts) tends to dampen the strength of the model.

Model 2: Change in Mortgage Value from 2006/7 to 2007/8

As in model 1, the baseline values are inversely related to the change in mortgage value at the end of the period, which tends to be stronger where owner-occupied velocity and the percentage of loans to owners-occupants is lower and mortgage values are higher. The latter relationship is the opposite of that found for mortgage value change over the longer period: at least at the end of the run-up in prices, a positive one-year change, indicating price resilience, is associated with markets where relative prices are higher.

Change variables display an expected relationship to resilience: where changes in loan values were higher between 2004/5 and 2007/8, shifts to higher shares of mortgages to owner-occupants, and increases in owner-occupied velocity are tied to higher price changes at the end of the period. Changes in investor purchase shares are negative, but weak.

Here again, the model's predictive power is weak: only 0.052, but the signs and relative strength of relationships between market resilience and candidate index components are of the predicted direction and strength.

Model 3: Percentage of Loans Distressed in December, 2008

Only two variables exert much influence on the percentage of loans in distress, but the predictive value of the model is very strong – an R-square of 0.628. As expected, the percentage of high cost loans at their peak is

strongly associated with higher rates of loan distress, and controlling for all other variables, distress is higher at the lower end of the market (as measured by relative loan value).

Results for Metropolitan Areas with the Largest Numbers of High-Poverty ZIP Codes

Although each of the variables used in these models is standardized within each metropolitan area, we have a strong interest in examining how well the models work across very different types of metropolitan areas – those experiencing very high run-ups in housing prices and those with more modest growth, as well as those with stronger and weaker job performance. To find out, we tested the three models in the 18 metropolitan areas containing 30 or more high-poverty ZIP codes. (We did this to ensure sufficient degrees of freedom in the model, as well as to include a sufficient number of areas that are the primary reason for index construction.) **Table 3** displays the result.

The three panels of **Table 3** show the beta weights for each of the model covariates. Significant relationships (at the 0.10 level) are highlighted in yellow. The last three columns of the table display the number of metropolitan areas for which a significant variable's sign is positive or negative, and for those where there is a preponderance of signs in a particular direction, the average beta for the group.

For the most part, the results of this analysis confirm the results of the analysis using all metropolitan areas. Taking only those variables where there is general agreement across metropolitan areas, high cost loans, mortgage values, owner velocity, and the percentage of loans to owner-occupants exert relatively strong effects on the performance indicators, taken as a group. For those variables where the signs are inconsistently positive or negative, there does not appear to be any pattern in the types of metropolitan areas that go one way or the other.

Table 3A
Regression Results for Zip Codes in Metros with More than 30 High-Poverty Zip Codes: Mortgage Value Change 2000/1 to 2007/8 is Dependent

Model	Atlanta	Birmingham	Boston	Chicago	Dallas	Detroit	Fresno	Houston	Los Angeles	Miami	New Orleans	New York	Philadelphia	Phoenix	Pittsburgh	Riverside	St.Louis	San Antonio	Positive Sign	Negative Sign	Average Beta
Owner-Occupied Transaction Velocity-00/01	-.271	-.125	-0.045	-0.226	-0.331	-0.052	-0.018	0.001	0.107	-0.166	-0.005	-0.059	0.005	-0.305	0.035	0.287	-0.216	0.166			
Investor Transaction Velocity 00/01	.162	.144	0.051	0.077	0.269	-0.142	0.261	-0.204	-0.058	-0.129	0.011	0.104	-0.013	0.336	-0.111	0.036	0.084	0.176			
Owner-Occupied Percentage 2001/2	-.136	-.171	0.275	-0.192	-0.069	0.292	0.594	0.065	-0.215	0.179	0.215	-0.230	0.118	-0.226	-0.085	-0.174	-0.053	0.164			
Relative Mortgage Value 2000/01	.078	-.959	-0.531	0.227	-0.111	-0.001	-0.855	-0.336	-0.043	-0.233	-0.843	-0.232	-0.428	0.085	-0.310	-0.679	-0.196	-0.911	1	12	-.484
Percent Loans to Owners 2000/1	-.300	.052	-0.170	-0.022	-0.387	-0.465	-0.243	-0.436	-0.267	-0.591	-0.090	-0.266	-0.251	-0.096	-0.375	0.328	-0.374	0.026			
Percent of Loans High Cost-2006/07	-.430	-.667	-0.155	-0.041	-0.306	0.073	-0.070	-0.333	0.203	0.122	-1.066	0.115	-0.312	-0.346	-0.471	-0.258	-0.456	-0.573	12	2	-.361
Change in Owner-Occupant Percentage of all Mortgages 2000/1 - 2004/5	.090	.324	-0.228	-0.159	0.201	0.270	0.132	0.042	-0.139	0.149	-0.131	-0.153	-0.055	-0.225	0.152	-0.213	0.128	0.214	4	5	
Change in Owner-Occupant Percentage of all Mortgages 2004/5 - 2007/08	.422	.005	-0.085	0.130	0.139	0.351	0.255	-0.039	0.089	-0.154	0.213	-0.095	0.004	0.152	0.085	-0.140	0.142	0.038	5	1	0.193
Change in Owner-Occupied Transactions 2000/1 - 2007/8	.044	-.004	0.064	0.053	0.113	0.388	0.185	0.405	0.512	0.110	0.017	-0.030	0.501	-0.267	0.079	0.154	0.121	0.038	4	0	0.452
Change in Investor Transactions 2000/1 - 2007/8	.353	-.095	-0.112	0.006	0.118	-0.092	0.067	-0.204	-0.367	-0.020	-0.019	0.199	-0.046	0.472	0.026	-0.102	0.128	-0.179	3	1	0.228
R-Square	**0.493**	**0.440**	**0.282**	**0.138**	**0.227**	**0.329**	**0.487**	**0.444**	**0.314**	**0.223**	**0.716**	**0.396**	**0.545**	**0.379**	**0.227**	**0.315**	**0.271**	**0.336**			**0.365**
N of Zip Codes	176	86	249	323	224	200	34	202	343	99	63	745	285	117	168	118	162	84			

Table 3B
Regression Results for Zip Codes in Metros with More than 30 High-Poverty Zip Codes: Mortgage Value Change 2006/7 to 2007/8 is Dependent

Model	Atlanta	Birmingham	Boston	Chicago	Dallas	Detroit	Fresno	Houston	Los Angeles	Miami	New Orleans	New York	Philadelphia	Phoenix	Pittsburgh	Riverside	St.Louis	San Antonio	Positive Sign	Negative Sign	Average Beta
Percent of Loans High Cost-2006/07	-0.383	-0.300	-0.553	-0.173	-0.457	-0.495	0.309	-0.304	-0.193	0.398	-0.587	0.139	-0.320	-0.130	-0.111	-0.185	-0.318	-0.090	10	2	-0.271
Owner-Occupied Transaction Velocity-06/07	0.003	-0.073	-0.001	0.199	-0.097	-0.103	-0.347	-0.383	-0.215	0.156	-0.201	-0.173	-0.081	-0.272	-0.385	-0.414	0.214	-0.600	2	5	-0.184
Investor Transaction Velocity 06/07	0.081	-0.055	0.179	0.423	0.250	-0.168	0.892	0.172	0.223	-0.327	0.245	0.116	0.046	-0.064	-0.034	0.008	-0.187	0.227	7	3	0.159
Relative Mortgage Value 2007/08	0.129	-0.165	-0.083	-0.151	-0.075	0.083	-0.025	-0.040	0.417	0.351	-0.136	0.248	-0.220	0.175	0.401	0.135	-0.067	-0.019	5	2	0.174
Change in Loan Value 2004/5 - 2007/8	-0.191	-0.299	-0.115	-0.042	0.097	-0.061	0.241	-0.049	0.069	0.013	-0.273	-0.141	-0.192	-0.048	-0.068	0.004	-0.033	-0.249	7	0	-0.209
Percent Loans to Owners 2007/8	0.123	-0.110	0.167	-0.220	-0.214	-0.708	0.990	0.154	0.014	-0.281	0.348	-0.053	-0.291	-0.292	-0.211	-0.381	0.133	0.364	5	8	
Change in Owner-Occupant Percentage of all Mortgages 2004/5 - 2007/08	-0.078	0.230	-0.028	0.297	0.196	0.586	0.057	-0.055	0.118	0.162	0.044	0.037	0.308	0.042	0.179	0.306	-0.044	-0.095	7	0	0.284
Change in Owner-Occupied Transactions 2000/1 - 2007/8	0.117	0.024	-0.054	-0.031	-0.041	0.181	-0.079	0.198	0.754	-0.445	-0.225	0.147	0.147	-0.156	0.291	0.473	0.075	0.431	7	1	0.249
Change in Investor Transactions 2000/1 - 2007/8	-0.237	0.094	-0.160	-0.024	-0.113	-0.032	0.394	-0.107	-0.656	0.488	-0.065	0.025	0.074	0.278	-0.280	-0.180	-0.183	-0.107	2	4	
R-Square	**0.296**	**0.010**	**0.259**	**0.291**	**0.188**	**0.417**	**0.423**	**0.166**	**0.310**	**0.257**	**0.305**	**0.074**	**0.232**	**0.232**	**0.238**	**0.286**	**0.157**	**0.144**			**0.238**
N of Zip Codes	176	86	249	323	224	200	34	202	343	99	63	745	285	117	168	118	162	84			

Table 3C
Regression Results for Zip Codes in Metros with More than 30 High-Poverty Zip Codes: Percent of Loans Distressed, 12/08

Model	Atlanta	Birmingham	Boston	Chicago	Dallas	Detroit	Fresno	Houston	Los Angeles	Miami	New Orleans	New York	Philadelphia	Phoenix	Pittsburgh	Riverside	St.Louis	San Antonio	Positive Sign	Negative Sign	Average Beta
Percent of Loans High Cost-2006/07	0.560	0.583	0.824	0.818	0.816	0.630	0.566	0.682	0.829	0.811	0.747	0.894	0.822	0.882	0.370	0.654	0.655	0.784	18	0	0.718
Owner-Occupied Transaction Velocity-06/07	-0.118	-0.062	-0.079	0.015	-0.194	-0.217	0.534	-0.109	-0.973	0.226	0.155	0.014	0.060	0.309	-0.172	0.431	0.009	0.190	6	7	
Investor Transaction Velocity 06/07	0.066	-0.086	0.034	-0.097	0.006	-0.095	0.051	0.029	1.054	-0.011	-0.111	-0.006	-0.007	-0.065	-0.051	0.084	-0.125	-0.250	1	3	
Relative Mortgage Value 2007/08	-0.332	-0.062	-0.182	-0.112	-0.087	-0.133	-0.323	-0.183	-0.146	-0.112	-0.216	-0.074	-0.136	0.002	-0.317	-0.202	-0.260	-0.183	0	13	-0.180
Change in Loan Value 2004/5 - 2007/8	-0.081	-0.099	0.035	0.042	0.036	0.039	0.235	0.033	0.089	0.083	0.378	-0.010	0.133	0.063	0.089	-0.060	0.144	-0.067	9	1	0.102
Percent Loans to Owners 2007/8	0.076	-0.352	0.084	-0.108	0.049	-0.266	-0.019	-0.009	-0.027	-0.176	-0.070	-0.067	0.084	0.036	-0.038	0.205	0.023	0.236	3	5	
Change in Owner-Occupant Percentage of all Mortgages 2004/5 - 2007/08	0.017	0.105	0.032	-0.002	-0.057	0.089	-0.196	0.060	-0.007	0.085	-0.174	0.035	-0.010	0.036	0.088	-0.037	-0.093	-0.032	2	2	
Change in Owner-Occupied Transactions 2000/1 - 2007/8	0.226	0.131	-0.057	0.128	0.189	0.227	-0.097	0.046	0.263	-0.231	-0.209	-0.023	-0.001	-0.280	0.026	-0.012	0.104	0.014	6	4	
Change in Investor Transactions 2000/1 - 2007/8	0.121	-0.028	0.030	-0.018	0.148	0.016	-0.135	0.194	-0.257	0.235	0.116	0.005	0.002	0.351	-0.052	0.061	-0.073	0.126	7	1	0.129
R-Square	**0.681**	**0.732**	**0.850**	**0.914**	**0.739**	**0.925**	**0.669**	**0.715**	**0.827**	**0.775**	**0.757**	**0.850**	**0.853**	**0.857**	**0.626**	**0.767**	**0.746**	**0.794**			**0.782**
N of Zip Codes	176	86	249	323	224	200	34	202	343	99	63	745	285	117	168	118	162	84			

Determination of Index Weights for Further Testing

The final step is to arrive at weights for testing in further analysis. The basis for assigning weights will be the presence and strength of a significant relationship between variables in the models and the three performance indicators. There is no straightforward way to do this, especially given that mortgage value appears as the dependent variable in model 1, but as a covariate in models 2 and 3. Therefore, we included the relative mortgage value at baseline to stand in for change in mortgage value. Results are presented in **Table 4.**

Table 4
Comparison of Beta Weights From 3 Models and Two Analysis Samples

Indicator	Metro Area Sample	All Metro Zip Codes (N = 12,078)	Weighted Average	Suggested Weight	Model 1/2	Model 1/2/3	Final Weights
Model 1							
High Cost Percentage	-0.361	-0.220	-0.267	-3.0			
Change in Owner Velocity	0.452	0.164	0.260	3.0			
Change in Investor Velocity	0.228	-0.044	0.047	0			
Change in Share Owner	0.193	0.029	0.084	1			
Relative Mortgage Value 2000/1	-0.484	-0.269	-0.341	4			
Model 2							
High Cost Percentage	-0.271	-0.098	-0.156	-1	-4.0		
Change in Owner Velocity	0.249	0.108	0.155	1	4.0		
Change in Investor Velocity							
Change in Share Owner	0.284	0.098	0.160	1	2.0		
Change in Mortgage Value	0.174	0.129	0.144	1	5.0		
Model 3							
High Cost	0.718	0.651	0.673	-7		-5	-4
Owner Velocity						4	3
Investor Velocity	0.129		0.043	1		1	1
Share Owner						2	2
Value	-0.180	-0.203	-0.195	2		5	6

In assigning weights, we first took the betas as found in the analysis of selected metropolitan areas and all metropolitan areas and averaged them, with 2/3 of the weight placed on the all-metro analysis and 1/3 on the selected metro area analysis (the "weighted average" column in Table 4.) The resulting average betas were then converted to rough whole-number equivalents (the "suggested weights" column in the table). In assigning these weights, we placed greater importance in the selected metropolitan area analysis to variables where there was near-unanimity among metro areas. These variables are highlighted in yellow.

We then added the implied weights for Models 1 and 2 (shown as "Model 1/2"), both which had weak R-squares, then further adjusted these weights based on the results from model three (Model 1/2/3). We then tested various weights for the Index, and settled on those shown in the lower right-hand corner of Table 3 under "Final Weights." To do these tests, we altered the high-

cost loan and mortgage value weights, and tested the alternatives by running simple correlations between loan distress and the three performance measures. The resulting weights produced the best overall fit across the three indicators.

It should be noted that the reduction in high-cost loan weight serves a further purpose: because the percentages of high-cost loans in the future are likely to be quite low, this weighting factor is likely to exert less and less influence in the resulting Index value. It will be quite important to test the 2008/9 index value on the recently-released 2009 HMDA data.

Comparison of Index Values and Full Model Results

There are two considerable virtues of the Index: first, it is a single number that summarizes several variables thought to be important to housing market strength, and as such, makes comparisons across neighborhoods very straightforward. However, the use of a single value comes with corresponding costs: it does not "predict" performance as well as a tailored model would, overall, and it does not perform equally well across all metropolitan area markets.

To give some idea of the tradeoffs involved, we compared the strength of the relationship between model variables fitted for each metropolitan area and the corresponding loan distress indicator to the relationship between the loan distress indicator and the Housing Market Index. The results are presented in **Table 5.**

In every instance, the metro-specific models produce R-square results that are superior to those produced by the HMI. There are two reasons for this: first, the average weights used in the HMI are necessarily inexact compared to the metro area-specific beta weights and second, the index contains only those variables measured at a point in time, and not the change variables included in the model. (This, of course, has the advantage of allowing researchers to track Index values year-in and year-out.)

Table 5
R-Square Results for HMI Index and Full Model
And Percentage of Loans in Distress

Metro Area	Full Model	HMI Index
Atlanta	0.681	0.461
Birmingham	0.732	0.602
Boston	0.850	0.634
Chicago	0.914	0.674
Dallas	0.739	0.480
Detroit	0.925	0.709
Fresno	0.669	0.235
Houston	0.715	0.513
Los Angeles	0.827	0.521
Miami	0.775	0.343
New Orleans	0.757	0.504
New York	0.850	0.388
Philadel	0.853	0.672
Phoenix	0.857	0.220
Pittsburgh	0.626	0.587
Riverside	0.767	0.064
San Antonio	0.746	0.613
St. Louis	0.794	0.482
Average for Subset	**0.782**	**0.483**
For All Metros	**0.629**	**0.437**

Overall, the model that regresses loan distress on the indicator variables (model 3) for all metropolitan areas explains 62.9 percent of the variance in loan distress percentages, compared to 43.7 percent of the variance predicted by the HMI. As well, HMI Index predictive value is lower in every metropolitan area than that of the full model.

Of particular interest are those metropolitan areas where differences between the full model and the Index are greatest. Those five metropolitan areas where R-square values for the HMI Index are less than 0.400 are highlighted in yellow. Four of these five are areas where the house price collapse in 2007/8 was particularly severe; these are all areas where owner-occupied transaction velocity is very high by our calculation, and positively associated with loan distress; in other words, owner velocity is a negative phenomenon in these metros, but the HMI treats owner-velocity as positive.

We believe this result is an artifact of our use of Census 2000 unit counts in the denominator used to calculate velocity. These unit counts are static, obviously, since there is no source of updated counts, but we know that in these markets in particular, very large numbers of new units came on

line during the analysis period. Until the ACS numbers become available in 2011, there is no remedy for this obvious flaw in the Index.

Tract Analysis and Testing in Selected Municipalities

The virtue of using ZIP code files is that housing performance can be assessed using multiple measures for the entire United States. The downside is that the analysis relies only on HMDA data, in which the volume and value of mortgages is taken to proxy these same features of the sales transactions themselves. Previous research has suggested that this assumption is warranted, but the previous work has not been extensive. Second, estimates of loan distress for the ZIP code analysis are based to some extent on estimates of loan delinquency and foreclosure activity using national loan servicer files. The best estimates, however, and assuming that the data have been adequately cleaned, come from jurisdiction's own legal records of *lis pendens* filings, property auctions, or other step in the foreclosure sequence.

To further assess the value of the HMI, we examined the relationship between the constituent indicators of the Index, based on HMDA data, and the same indicators as measured using local administrative data. We also examined the relationship between the HMI and local foreclosure experience. Where available, we looked at tax delinquencies and housing permit activity, as well.

One further analysis was carried out: the HMI index in the ZIP code analysis was carried out using scores standardized across all ZIP codes, regardless of their relative income. This means that scores are based on means and standard deviations that include both higher income and lower-income ZIP codes. But the HMI is intended to discriminate among low- and moderate-income areas, primarily, which is almost certain to reduce variation on both measures of performance and components of the index. This means that the predictive value of an index constructed for low- and moderate-income areas, only, should be expected to be lower. This effect may be more pronounced within particular metropolitan areas, especially where the number of low- and moderate-income tracts is relatively small. Therefore, several of the tables distinguish between index values based on all tracts in the metropolitan area, and values based only on low- and moderate-income areas.

Tables 6 and 7 compare median tract mortgage values from HMDA to median sales prices for single-family parcels (in four of the five cases) and the numbers of first-mortgage transactions and numbers of property sales. These are done for all tracts, and for low- and moderate-income tracts, only.

Table 6
Correlations Between Locally-Measured Median Sales Price and HMDA Median Mortgage Value

Year	Providence (a)	Milwaukee (b)		Minneapolis (c)		St. Paul (d)		Indianapolis (e)	
	Low-Mod Tracts (N = 32)	*Low-Mod Tracts* (N = 149)	*All Tracts* (N = 215)	*Low-Mod Tracts* (N = 80)	*All Tracts* (N = 121)	*Low-Mod Tracts* (N = 50)	*All Tracts* (N = 79)	*Low-Mod Tracts* (N = 112)	*All Tracts* (N = 208)
2004	0.929			0.664	0.682	0.527	0.686	0.939	0.938
2005	0.724	0.942	0.957	0.474	0.530	0.262	0.587	0.907	0.895
2006	0.235	0.927	0.929	0.548	0.590	0.269	0.747	0.832	0.862
2007	0.679	0.921	0.927	-0.003	0.227	0.505	0.682	0.830	0.864
2008	0.523	0.743	0.825	0.619	0.762	0.670	0.553	0.840	0.875

(a) Median Price of All Residential Sales
(b) Median Price for Single-Unit, Condo, Duplexes
(c) Median Sales Price of Single-Family Parcels
(d) Median Sales Price of Single-Family Parcels
(e) Median Sales Price of Single-Family Parcels Over Past Three Years

Table 7
Correlations Between Locally-Measured Sales Volume and HMDA Mortgage Volume

Year	Providence (a)	Milwaukee (b)		Minneapolis (c)		St. Paul (d)		Indianapolis
	Low-Mod Tracts (N = 32)	*Low-Mod Tracts* (N = 149)	*All Tracts* (N = 215)	*Low-Mod Tracts* (N = 80)	*All Tracts* (N = 121)	*Low-Mod Tracts* (N = 50)	*All Tracts* (N = 79)	
2004	0.965					0.037	0.178	N/A
2005	0.984	0.858	0.889	0.705	0.392	0.535	0.488	
2006	0.940	0.868	0.845	0.696	0.621	0.516	0.498	
2007	0.848	0.856	0.857	0.439	0.435	0.065	0.444	
2008	0.720	0.837	0.911	0.655	0.684	0.166	0.160	

(a) Total Number of Residential Parcels Sold
(b) Number of Sales for Single-Unit, Condo, Duplexes
(c) Number of Single-Family Sales
(d) Number of Single-Family Sales / Number of Single-Family Parcels

This analysis confirms results from previous studies in other cities that find a generally strong relationship between median mortgage amounts and median residential sales prices. The best results overall are obtained in Milwaukee and Indianapolis. In the other cities, results are inconsistent: strong correlations in some years, but not others. It may be that the unusual behavior of the housing market in those years suppresses what otherwise would be strong correlations. These uneven results may be one source of error in the predictive models built on HMDA data. In addition, and as expected, there is some loss in the predictive power of HMDA mortgage values if only low-income tracts are included in the analysis. That said, this loss is not serious in most cases.

Correlations between sales volume and volume of mortgage transactions are generally better than that for median mortgage values, but with odd exceptions for St. Paul in certain years. This is probably because the sales volume variable in St. Paul is measured as a rate (sales divided by number of parcels) rather than as a simple number of sales.

Using the same weights as in the national and metropolitan area ZIP code analysis, **Table 8** shows the relationship between index values constructed for each two-year period from 2005/6 to 2007/8 and the average foreclosure rates for selected parcel types in the same period. The results are strong in some cities and in some years, weaker in some cities and in other years.

Table 8
Correlations Between HMI Scores and Foreclosure Rate in Selected Years

		2005/6	2006/7	2007/8
Providence (a)	All Metro	-.565/-.320	-.291/-.788	-.777/-.777
	Low-Mod Only	-0.479/-0.006	-.033/-.733	-.712/-.712
Milwaukee (b)	All Metro	-0.370	-0.427	-0.569
	Low-Mod Only	-0.242	-0.336	-.426
Minneapolis (c)	All Metro	-0.685	-0.649	-0.327
	Low-Mod Only	-0.736	-0.603	-0.619
St. Paul (d)	All Metro	-0.759	-0.809	-0.856
	Low-Mod Only	-0.608	-0.711	-0.759
Memphis (e)	All Metro			-0.664
	Low-Mod Only			-0.364

(a) Average Foreclosure Rate for Single-Unit, Condos, and 2-5 Units
(b) Average Foreclosure Rate for Single-Unit, Condo, Duplexes
(c) Average Foreclosure Rate for All Residential Parcels
(d) Average Foreclosure Rate for All Residential Parcels
(e) Average Foreclosure Rate for All Residential Parcels

Taking only the comparisons for 2007/8, results are reasonably strong for the low-mod only index construction in Providence (-0.712 in both 2007 and 2008) Minneapolis (-0.619) and St. Paul (-0.759). Milwaukee results are modest, only somewhat better in Memphis (for which we had only aggregated foreclosure data covering the 2004-2008 period).

In all cases (except Providence, for which the number of tracts was too small to allow multiple regression), we also compared the R-square results from a multivariate regression of foreclosure rates on index components and the R-square obtained from the simple correlations between the HMI and foreclosure rates (presented in **Table 8). Table 9** shows the result. In all cases, the multivariate regression produces much stronger results than the HMI alone.

Table 9
R-Square Results for Regression of Foreclosure Rate on HMI Components

Site	**HMI Index** (Bivariate)	**All Components** (Multiple)
Providence (a)	0.507	N/A
Milwaukee (b)	0.181	0.469
Minneapolis (c)	0.383	0.718
St. Paul (d)	0.576	0.779
Memphis (e)	0.132	0.274

(a) Average Foreclosure Rate for Single-Unit, Condos, and 2-5 Units
(b) Average Foreclosure Rate for Single-Unit, Condo, Duplexes
(c) Average Foreclosure Rate for All Residential Parcels
(d) Average Foreclosure Rate for All Residential Parcels
(e) Average Foreclosure Rate for All Residential Parcels

The superiority of multiple regressions compared to simple index values is explained by the differences in the signs and size of the beta weights for variables in the multiple regressions compared to their treatment in the index. (See **Table 10**.) Where the size and signs are similar, as in St. Paul, the two methods produce similar results. Where the sizes and signs are different, the HMI produces weaker results, for obvious reasons. That said, where the specific covariates are significant in the multiple regression equation, the index weights are at least roughly comparable except for loan value (which for theoretical reasons we have weighted more heavily) and for investor velocity (which are significant and positive in Minneapolis, Milwaukee, and Memphis.) These results, carried out in a very small number of cities, do not convince us that the weighting arrived at based on ZIP code analysis should be altered.

Table 10
Beta Values for Regression of Foreclosure Rate in 2007/2008 on Components of HMI

Component	Minneapolis	St. Paul	Memphis	Milwaukee	Index Weights (Reverse Sign)
R-Square	**0.718**	**0.779**	**0.274**	**0.469**	**n/a**
High Cost Loans 2007/8	*0.775*	*0.451*	*0.363*	*0.496*	0.400
Loan Value	-0.104	*-0.341*	0.145	*-0.140*	-0.600
Percent Purchases by Owner	-0.013	*-0.394*	0.028	-0.090	-0.200
Owner Velocity	0.017	0.349	*-0.309*	*0.277*	-0.300
Investor Velocity	*0.188*	*0.030*	*0.375*	*0.262*	-0.100

Some comfort to that decision is lent by the results obtained in correlating the HMI with other indicators of market performance. The results are shown in **Table 11**. In Providence, the index is strongly associated with the percent of residential parcels with new construction or remodeling building permits. In Minneapolis, the HMI predicts both foreclosure rate and remodeling permit rate about equally well. In Milwaukee, the HMI only moderately predicts foreclosure rate, but is strongly associated with tax delinquency.

Table 11
Correlation Coefficients for Low-Mod Tract HMI Index and Selected Indicators of Loan Distress

	Simple Correlation
Providence	
Percent All Residential Parcels Foreclosed, 2008	-0.712
Percent Residential Parcels Tax Delinquent, 2008	-0.475
Percent of Residential Parcels with Building Permits, 2008	0.807
Minneapolis	
Percent Residential Parcels Foreclosed, 2007-2008	-0.619
Remodelling Permits / Single Family Parcels 2007	0.618
St. Paul	
Percent Single Family Properties Foreclosed, 2008	-0.716
Percent Residential Parcels Foreclosed, 2008	-0.771
Milwaukee	
Percent Residential Parcels Foreclosed, 2007-2008	-0.426
Percent Residential Parcels Tax Delinquent, 2007-2008	-0.704
Memphis	
Percent Residential Parcels Foreclosed, 2004-2008	-0.528

Further Local Testing

We compared HMI levels and trends across neighborhoods in Washington, D.C. to further test whether the behavior of the index comported with expert understandings of how local housing markets are changing. We did this by grouping neighborhoods into terciles of HMI value in 2007/8 and terciles of HMI value change between 2004/5 and 2007/8. This allows construction of nine groups of neighborhoods based on HMI level and change. Overall, these groups appeared to match expert views on comparative neighborhood performance. Two insights from this analysis are worth reporting:

- Differences in stock characteristics may matter: large numbers of condominium loans can drive down median mortgage amount (as might lower first liens because a larger portion of the purchase price is covered by second liens).

- New housing construction, including HOPE VI projects, appears to drive increases in the housing market index in several neighborhoods. This is in part because there were small numbers of owner-occupied units prior to construction.

One implication of this analysis is that the Index should not be considered a complete substitute for examining individual components to understand how relative status and changes in status as measured by the HMI are driven by the values of specific indicators.

Analysis of HMI and Tract Racial / Ethnic Change

The market performance indicators of loan distress, foreclosure, building permits, and tax delinquencies used in analyzing the predictive power of the HMI are not available in HMDA or other national tract data. To further test the HMI, we resort to a theorized relationship between changes in the racial and ethnic composition of tracts and the relative strength of housing markets. We expect that the generally superior purchasing power of white buyers and the resulting breadth of choice they exercise across housing sub-markets mean that neighborhoods where whites are a growing presence should display higher HMI values than those where white shares are declining. Although we do not test this explicitly using the buyer income data available from HMDA, we surmise that low- and moderate-income tracts with a growing white presence are most likely those that are gentrifying in terms of shifting residential population shares toward a better-educated and higher-income owners.

Specifically, tracts that are majority-minority, but in which white homebuyers are a substantial and growing minority, should display higher HMI values than other types of tracts. (Tracts with trace percentages of whites are excluded from this analysis because they quite often show very high percentages of white buyers relative to a low baseline percentage.) To find out, we first classified all 17,595 metropolitan area low- and moderate-income tracts according to their racial and ethnic composition in 2000, estimated likely racial-ethnic shifts based on the characteristics

of homebuyers over the 2004 to 2008 period, and then compared the HMI across the resulting tract categories.

We distinguished tracts according to their racial-ethnic composition in 2000 by defining three types of tracts: (1) those in which one race-ethnicity accounted for more than 75 percent of the population, (2) those in which one race-ethnicity comprised between 50-75 percent of the population, and (3) those in which no race constituted a majority. **Table 12** shows the results.

Table 12
Neighborhood Racial Composition of Low-and-Mode
Census Tracts in 2000

Category	**Number of Tracts**	**Percent**
Category 1		
White dominant	3,674	20.9
Black dominant	3,015	17.1
Hispanic dominant	1,410	8.0
Asian dominant	61	0.3
Subtotal	*8,160*	*46.4*
Category 2		
White-Black	885	5.0
White-Hispanic	696	4.0
White-Asian	73	0.4
White-Mixed	1,741	9.9
Black-White	787	4.5
Black-Hispanic	298	1.7
Black-Asian	7	0.0
Black-Mixed	554	3.1
Hispanic-White	666	3.8
Hispanic-Black	353	2.0
Hispanic-Asian	57	0.3
Hispanic-Mixed	782	4.4
Asian-White	34	0.2
Subtotal	*6,933*	*39.4*
Category 3		
No Race Majority	2,502	14.2
Total	17,595	100.0

Category 1 tracts are labeled White-dominant, Black-dominant, Hispanic-dominant, and Asian-dominant; together these tracts amount to 45.3 percent of all low-mod census tracts in metropolitan areas. Category 2 tracts are labeled by the majority race-ethnicity followed by any racial-ethnic category that constituted at least 25 percent of tract population. For example, White-

Black tracts are those in which whites were between 50-75 percent of the population and blacks were between 25-50 percent. Tracts where no other group but the majority accounted for more than 25 percent of population are indicated as Mixed (as in White-Mixed). Category 3 tracts are identified as No Race Majority.

We expect that tracts in categories with large white percentages will have high HMI values relative to other tracts; tracts in categories with large black percentages will have low HMI values. As shown in **Table 13**, this is indeed the case. For each tract category, the average HMI for the category is shown. Categories are ranked in descending order of HMI values.

Table 13

Average Housing Market Index Values for 2007/8
By Neighborhood Racial Composition of Low-and-Moderate Income
Census Tracts in 2000

	Median HMI	Average HMI	Number of Tracts
Asian-White	0.83	0.55	30
White-Asian	0.55	0.73	65
White dominant	0.16	0.22	3,585
White-Mixed	0.13	0.21	1,656
White-Black	0.10	0.25	845
Asian dominant	0.10	0.41	56
Hispanic-White	0.05	0.10	662
White-Hispanic	-0.01	0.07	690
No Race Majority	-0.07	0.01	2,402
Hispanic-Asian	-0.09	0.19	56
Hispanic dominant	-0.13	-0.07	1,360
Hispanic-Mixed	-0.14	-0.08	756
Hispanic-Black	-0.19	-0.17	330
Black-White	-0.21	-0.02	762
Black-Mixed	-0.25	-0.27	535
Black-Hispanic	-0.39	-0.35	270
Black dominant	-0.55	-0.46	2,883
Black-Asian	-0.84	-0.75	4
Total	-0.08	-0.02	17,114

We also expect that tracts that are trending white will display higher HMI values. To roughly gauge changes in the racial and ethnic composition of neighborhoods, we examined the racial-ethnic composition of home mortgage borrowers as reported in HMDA data, including only those who were owner-occupants (as opposed to investors, unlikely to reside in the property) and counting only first liens. We divided tracts into (1) those where the share of homebuyers of a particular race-ethnicity was less than 50 percent of their share in the population in 2000, (2)

those where the buyer share was between 50 and 150 percent of their population share, and (3) those where the buyer share was 150 percent of their population share or more.

For example, if the white population share in 2000 was 30 percent, then category 1 tracts are those in which the white percentage of all buyers was 15 percent or less, category 2 tracts have white buyer percentages of 15 percent to 45 percent, and category 3 tracts have white buyer percentages over 45 percent. This classification is meaningful only where the percentage of buyers of a particular race is more than 25 percent and less than 75 percent; i.e., only for those tracts that fall into our second category of tracts based on racial-ethnic percentages in 2000.

Table 14 shows the numbers of tracts where whites represented either the majority of the population or a significant minority, cross-tabulated by the buyer-population ratio categories. We also included tracts that have no race-ethnic majority (even though the numbers of whites in some of these tracts may be quite low). Of particular interest are tracts in which whites are a significant minority, but white buyers represent a high proportion of all buyers relative to their population share. In other words, these are tracts that have substantial white minorities and would appear to be trending white.

Table 14

Neighborhood Racial Composition in 2000
and Ratio of White Buyers to White Population 2004-2008
(Number of Tracts)

	Ratio of White Buyers to White Population			
Category	Less Than 50%	Between 50-150%	More Than 150%	Total
White-Asian	12	50	8	70
White-Black	48	683	144	875
Asian-White	9	15	10	34
White-Mixed	67	1,594	64	1,725
White-Hispanic	57	585	52	694
Hispanic-White	88	359	218	665
Black-White	72	331	378	781
No Majority	225	1,331	915	2,471
White-Dominant	39	3,609		3,648
Total	617	8,557	1,789	10,963

For each cell in **Table 14**, we calculated the average HMI. Results are shown in **Table 15**. (The table ordered in decreasing values of HMI for tracts that appear to be gaining white population share.) In all cases, HMI values are higher where tracts would appear to be trending white based on the ratio of home buyers to current (2000) population, compared to those where whites are

declining. The magnitude of the effect of white population change is suggested by the last column labeled "range," in which we calculated the difference between average HMI values for tracts where whites appear to be increasing versus those where whites appear to be decreasing. (We did not detect any consistent pattern of change for the percentage of buyers in other racial or ethnic groups relative to their population percentage.)

Table 15

Housing Market Index 2007/8 By Neighborhood Racial Composition in 2000 and Ratio of White Buyers to White Population 2004-2008

	Ratio of White Buyers to White Population			
Category	Less Than 50%	Between 50-150%	More Than 150%	Range
White-Black	-0.32	0.01	0.99	1.31
Hispanic-White	-0.45	-0.09	0.56	1.01
White-Mixed	0.08	0.11	1.04	0.96
White-Hispanic	-0.26	-0.03	0.68	0.94
Black-White	-0.35	-0.43	0.30	0.65
White-Asian	0.58	0.53	1.19	0.61
Asian-White	0.23	0.93	0.82	0.59
No Majority	-0.12	-0.22	0.25	0.37
White-Dominant	-0.03	0.17		
Average	-0.07	0.11	0.73	0.80

Finally, we examined whether change in the HMI between 2004/5 and 2007/8 is higher for those tracts that would appear to be trending white based on our buyer-population comparison. The results, shown in **Table 16**, are not as strong as those for the single year comparisons shown in **Table 15**, but the pattern holds nonetheless, except for the puzzling exception of Black-Majority/White-Minority tracts, where those tracts that displayed high white buyer-population ratios fared worse on the HMI than those where those ratios were lower.

Use of the Index in Local Applications

We believe that the HMI works reasonably well, especially for an index built on relatively few factors and constructed based on national patterns. In the tests reported here, the Index predicts foreclosure rates across large numbers of ZIP codes, and does well, but unevenly so, in several local tests using local foreclosure data. It predicts several other indicators of market performance where those are available to this analysis. Finally, it seems to match expert judgments of market strength in the one city where this analysis was done.

Table 16
Change in Housing Market Index 2004/5 to 2007/8 By Neighborhood Racial Composition in 2000 and Ratio of White Buyers to White Population 2004-2008

	Ratio of White Buyers to White Population			
Category	Less Than 50%	Between 50-150%	More Than 150%	Range
White-Asian	-0.31	-0.12	0.31	0.62
White-Mixed	-0.23	-0.04	-0.05	0.18
White-Black	0.01	-0.02	-0.05	-0.06
White-Hispanic	-0.23	-0.04	-0.05	0.18
Asian-White	-0.41	-0.18	-0.18	0.23
Hispanic-White	-0.07	-0.11	0.02	0.09
Black-White	-0.18	-0.05	-0.01	0.17
No Majority	-0.07	-0.07	0.02	0.08
White-Dominant	-0.38	-0.04		
Average	-0.21	-0.07	0.00	0.19

That said, the index can be improved through further analysis at the local level where other measures of market performance are available. As shown in the analyses for Milwaukee, Minneapolis, St. Paul, and Memphis, alternative beta weights (and thus, weighting of HMI components) can be constructed with a simple regression of market data, like foreclosure rates, on the index components. Reweighting the HMI components improves the predictive value of the index.

METHODOLOGICAL APPENDIX

Data Adjustments and Considerations

This appendix describes some of the ways HMDA data were treated to construct HMI scores.

In some iterations of the index, we excluded tracts with fewer than 10 loans from the analysis. We chose not to do this for subsequent analysis, including the analysis in this paper. In some cases, this choice results in extreme values on owner- and investor-velocity indicators. The z-score transformation reduces the effect of this somewhat.

In earlier iterations of the index, we excluded tracts in which more than 60 percent of the population resided in group quarters, such as barracks, dormitories or prisons. (Persons residing in group quarters amount to 4 percent of the population in the average tract, 8.8 percent at the 90th percentile.) We chose not to do this in this analysis; local applications of the Index should be aware that some census tracts, like those near college campuses, might appear as low- and moderate-income as a result.

In the calculation, to obtain the best approximation of purchase prices, only first-lien mortgages are included; i.e., lower-value junior liens have been excluded. (If first liens and junior liens could be linked in HMDA data, which they cannot be without extensive analysis, the combined value would be a superior measure to first liens, only.)

All mortgages are home-purchase single-family, only, and exclude refinancing. This is done to obtain the best approximation of home purchases for the purposes of calculating velocity, as well as to exclude lower-value refinance mortgages (which would distort the purchase price approximation).

Approximately 3,000 of the 17,700 low-mod metropolitan census tracts have no owner-occupied or investor loans in 2000 and 2001. As a result, these tracts have undefined values for the owner-occupied and investor change indicators and without any data adjustments, could not be used to calculate several of the covariates used in the analysis. (These indicators are not used in the Housing Market Index.) In order to use these tracts in analysis, we modified the loan counts for the 2000-2001 two-year average from zero to one. We modified the owner-occupied loans counts for the 2000-2001 two-year average in 359 census tracts and modified the investor counts in 2,914 census tracts.

Data Components of the Housing Market Index

From the Home Mortgage Disclosure Act:

Median Home Purchase First Lien Loan Amount 2004

Median Home Purchase First Lien Loan Amount 2005
Median Home Purchase First Lien Loan Amount 2006
Median Home Purchase First Lien Loan Amount 2007
Median Home Purchase First Lien Loan Amount 2008
All Home Purchase Owner-Occupied First Lien Loans 2004
All Home Purchase Owner-Occupied First Lien Loans 2005
All Home Purchase Owner-Occupied First Lien Loans 2006
All Home Purchase Owner-Occupied First Lien Loans 2007
All Home Purchase Owner-Occupied First Lien Loans 2008
All Home Purchase Investor First Lien Loans 2004
All Home Purchase Investor First Lien Loans 2005
All Home Purchase Investor First Lien Loans 2006
All Home Purchase Investor First Lien Loans 2007
All Home Purchase Investor First Lien Loans 2008
High Cost Home Purchase First Lien Loans 2004
High Cost Home Purchase First Lien Loans 2005
High Cost Home Purchase First Lien Loans 2006
High Cost Home Purchase First Lien Loans 2007
High Cost Home Purchase First Lien Loans 2008

From the US Census

Owner-Occupied Units 2000
Single Family (1-4 Unit) Rental Units 2000

Description of Loan Distress Indicators Used in Market Performance Analysis

(1) Weighted number of loans from LPS Applied Analytics to correct for undercounting of outstanding mortgages

LPS Applied Analytics releases its data at the ZIP code level, but the data are incomplete, as are all other loan performance data sources. To correct for this, we weighted up the number of loans from the LPS Applied Analytics file to the estimated number of total housing units with a mortgage.

Total outstanding mortgage counts were first calculated for the March 2008 data release. Mortgage loans outstanding include all mortgaged owner-occupied units, plus 44 percent of the one-to-four unit rental units – the percentage of units with residential mortgages in the 2002 Residential Finance Survey. We used the number of mortgaged owner-occupied units and 44 percent of the one-to-four unit rental units from the 2006 American Community Survey (ACS) to estimated the number of homes with mortgage loans outstanding in the 2007 US Census county-level counts of total housing units. ACS county level data were used to estimate the 2007 share of

homes with mortgage loans outstanding for the 783 counties in the ACS and state proportions were used for remaining counties. We then applied the distribution of each county's mortgage loans across ZIP codes.

To calculate outstanding mortgages for March 2010, the mortgage counts resulting from the above analysis were weighted by Mortgage Bankers Association (MBA) change in total mortgages by state from March 2008 to March 2010. March 2010 LPS Applied Analytics percentages of foreclosures, subprime and delinquent loans in each ZIP were used to calculate new counts based on adjusted total of outstanding mortgages.

(2) Further adjusted the interim LPS Applied Analytics subprime loan counts to match counts from the Mortgage Bankers Association (MBA), the best source on the number of subprime loans.

The MBA's March 2010 2008 National Delinquency Survey (NDS) provides more accurate state-level percentages of subprime loans, so we multiplied the MBA shares by our estimated number of outstanding mortgage loans to create control counts for subprime loans by state. The state adjustment was applied to each ZIP code's number of subprime loans, so our state counts of subprime loans equaled the MBA totals.

(3) Adjusted interim state totals of foreclosures and delinquencies with results from the NDS.

In the states where LPS Applied Analytics counts of foreclosures and delinquent loans fell short of the NDS totals for these categories, the counts were pro-rata adjusted across all ZIP codes to produce counts equal to the MBA totals for both subprime and total loans. (In some states, the NDS showed lower delinquency or foreclosure percentages than calculated from LPS Applied Analytics, in which case the higher estimates were retained.) These steps ensured a reasonable correspondence between estimates from two different sources of mortgage loan, delinquency, and foreclosure information, and while doing so, maintained the relative inter-state proportions.

Appendix Table 1: Descriptive Statistics for HMI Components (All Tracts)

	N	Minimum	Maximum	Mean	Std. Deviation
OwnerOccupiedTransactionVelocity_2004_2005	50693	.00	61.25	.0915	.52446
InvestorTransactionVelocity_2004_2005	50640	.00	32.63	.0946	.49716
MortgageValue_2004_2005	50938	9000.00	2809000	194134.3	136801.41998
PercentLoansToOwners_2004_2005	50752	.00	1.00	.8403	.14319
PercentHighCost_2004_2005	50752	.00	1.00	.2000	.15380
OwnerOccupiedTransactionVelocity_2005_2006	50700	.00	73.25	.0916	.58011
InvestorTransactionVelocity_2005_2006	50644	.00	42.11	.0986	.51100
MortgageValue_2005_2006	50912	9000.00	2657500	212454.8	153129.19150
PercentLoansToOwners_2005_2006	50677	.00	1.00	.8358	.14233
PercentHighCost_2005_2006	50677	.00	1.00	.2683	.18421
OwnerOccupiedTransactionVelocity_2006_2007	50679	.00	56.50	.0779	.48765
InvestorTransactionVelocity_2006_2007	50623	.00	41.11	.0753	.39315
MortgageValue_2006_2007	50853	11000.00	3104000	220518.1	157991.80777
PercentLoansToOwners_2006_2007	50606	.00	1.00	.8443	.13832
PercentHighCost_2006_2007	50607	.00	1.00	.2363	.17273
OwnerOccupiedTransactionVelocity_2007_2008	50627	.00	33.50	.0587	.34053
InvestorTransactionVelocity_2007_2008	50558	.00	14.00	.0507	.24834
MortgageValue_2007_2008	50718	10000.00	3112000	212050.9	147178.17274
PercentLoansToOwners_2007_2008	50466	.00	1.00	.8511	.13828
PercentHighCost_2007_2008	50468	.00	1.00	.1555	.13876
Valid N (listwise)	49967				

Appendix Table 2: Descriptive Statistics for HMI Components, by Non-Low-Mod and Low-Mod Tracts (LOWMODTRACT = 1)[a]

LOWMODTRACT		N	Minimum	Maximum	Mean	Std. Deviation
0	OwnerOccupiedTransactionVelocity_2004_2005	33308	.00	54.61	.0894	.49082
	InvestorTransactionVelocity_2004_2005	33140	.00	32.63	.1186	.57431
	MortgageValue_2004_2005	33474	9000.00	2243500	214838.1	143310.56437
	PercentLoansToOwners_2004_2005	33387	.00	1.00	.8849	.09923
	PercentHighCost_2004_2005	33387	.00	1.00	.1450	.10116
	OwnerOccupiedTransactionVelocity_2005_2006	33304	.00	66.21	.0864	.51319
	InvestorTransactionVelocity_2005_2006	33139	.00	42.11	.1232	.60185
	MortgageValue_2005_2006	33453	15000.00	2657500	233595.8	160423.14592
	PercentLoansToOwners_2005_2006	33343	.00	1.00	.8783	.10198
	PercentHighCost_2005_2006	33343	.00	1.00	.2015	.12981
	OwnerOccupiedTransactionVelocity_2006_2007	33301	.00	48.02	.0721	.39045
	InvestorTransactionVelocity_2006_2007	33137	.00	41.11	.0930	.45127
	MortgageValue_2006_2007	33427	14500.00	3104000	241608.8	165710.22372
	PercentLoansToOwners_2006_2007	33318	.00	1.00	.8836	.09918
	PercentHighCost_2006_2007	33319	.00	1.00	.1754	.11826
	OwnerOccupiedTransactionVelocity_2007_2008	33287	.00	30.83	.0565	.29351
	InvestorTransactionVelocity_2007_2008	33128	.00	14.00	.0630	.28300
	MortgageValue_2007_2008	33388	14500.00	3112000	233746.0	154097.37989
	PercentLoansToOwners_2007_2008	33302	.00	1.00	.8896	.09745
	PercentHighCost_2007_2008	33303	.00	1.00	.1118	.08814
	Valid N (listwise)	33021				
1	OwnerOccupiedTransactionVelocity_2004_2005	17385	.00	61.25	.0954	.58351
	InvestorTransactionVelocity_2004_2005	17500	.00	26.60	.0492	.29576
	MortgageValue_2004_2005	17464	10000.00	2809000	154450.3	113244.27447
	PercentLoansToOwners_2004_2005	17365	.00	1.00	.7546	.17272
	PercentHighCost_2004_2005	17365	.00	1.00	.3058	.18016
	OwnerOccupiedTransactionVelocity_2005_2006	17396	.00	73.25	.1014	.69028
	InvestorTransactionVelocity_2005_2006	17505	.00	18.70	.0519	.25768
	MortgageValue_2005_2006	17459	9000.00	2269000	171946.7	128725.19175
	PercentLoansToOwners_2005_2006	17334	.00	1.00	.7540	.17045
	PercentHighCost_2005_2006	17334	.00	1.00	.3969	.20411
	OwnerOccupiedTransactionVelocity_2006_2007	17378	.00	56.50	.0890	.63340
	InvestorTransactionVelocity_2006_2007	17486	.00	22.80	.0418	.24465
	MortgageValue_2006_2007	17426	11000.00	1725000	180061.6	132966.01066
	PercentLoansToOwners_2006_2007	17288	.00	1.00	.7685	.16832
	PercentHighCost_2006_2007	17288	.00	1.00	.3537	.19860
	OwnerOccupiedTransactionVelocity_2007_2008	17340	.00	33.50	.0631	.41612
	InvestorTransactionVelocity_2007_2008	17430	.00	13.20	.0272	.16073
	MortgageValue_2007_2008	17330	10000.00	2600000	170253.0	122443.29975
	PercentLoansToOwners_2007_2008	17164	.00	1.00	.7763	.17126
	PercentHighCost_2007_2008	17165	.00	1.00	.2402	.17511
	Valid N (listwise)	16946				

a. No statistics are computed for one or more split files because there are no valid cases.

Appendix Table 3: Correlations Among HMI Components (All Tracts)

		Owner Occupied Transaction Velocity_2007_2008	Investor Transaction Velocity_2007_2008	Mortgage Value_2007_2008	Percent LoansTo Owners_2007_2008	PercentHigh Cost_2007_2008
OwnerOccupiedTransactionVelocity_2007_2008	Pearson Correlation	1	.186**	.033**	.007	-.049**
	Sig. (2-tailed)		.000	.000	.114	.000
	N	50627	50379	50459	50295	50297
InvestorTransactionVelocity_2007_2008	Pearson Correlation	.186**	1	.037**	-.134**	-.054**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	50379	50558	50362	50177	50179
MortgageValue_2007_2008	Pearson Correlation	.033**	.037**	1	.197**	-.353**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	50459	50362	50718	50466	50468
PercentLoansToOwners_2007_2008	Pearson Correlation	.007	-.134**	.197**	1	-.317**
	Sig. (2-tailed)	.114	.000	.000		.000
	N	50295	50177	50466	50466	50466
PercentHighCost_2007_2008	Pearson Correlation	-.049**	-.054**	-.353**	-.317**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	50297	50179	50468	50466	50468

**. Correlation is significant at the 0.01 level (2-tailed).

pendix Table 4A: Desciptive Statistics for HMI Component Standardized Scores for All Metro Tracts (MetroScore) and Low-Mo Tracts Only (LowModMetroScore)

	N	Minimum	Maximum	Mean	Std. Deviation
OwnerOccupiedTransactionVelocity_2007_2008_ LowModMetroScore	17340	-2.97	35.18	.0000	.99204
OwnerOccupiedTransactionVelocity_2007_2008_MetroScore	50627	-3.56	56.89	.0000	.99728
InvestorTransactionVelocity_2007_2008_MetroScore	50558	-1.89	47.72	.0000	.99728
MortgageValue_2007_2008_MetroScore	50718	-3.37	14.42	.0000	.99729
PercentLoansToOwners_2007_2008_MetroScore	50466	-8.13	2.31	.0000	.99727
PercentHighCost_2007_2008_MetroScore	50468	-2.95	9.92	.0000	.99727
InvestorTransactionVelocity_2007_2008_LowModMetroScore	17430	-2.19	27.52	.0000	.99208
MortgageValue_2007_2008_LowModMetroScore	17330	-3.30	19.70	.0000	.99203
PercentLoansToOwners_2007_2008_LowModMetroScore	17164	-6.54	2.43	.0000	.99196
PercentHighCost_2007_2008_LowModMetroScore	17165	-2.71	7.00	.0000	.99196
Valid N (listwise)	17039				

Appendix Table 4B: Descriptive Statistics for HMI Scores 2004/5 to 2007/8 - All Tracts (HMISCORE) and Low-Mod Tracts (LHMISCORE)

	N	Minimum	Maximum	Mean	Std. Deviation
HMISCORE_0405_rev	50270	-5.21	11.80	-.0071	1.06747
HMISCORE_0506_rev	50243	-4.57	14.86	-.0071	1.06146
HMISCORE_0607_rev	50196	-4.84	20.01	-.0082	1.05287
HMISCORE_0708_rev	50076	-6.53	20.07	-.0069	1.05332
LHMISCORE_0405_rev	17206	-4.15	9.63	-.0102	1.01737
LHMISCORE_0506_rev	17186	-4.71	11.59	-.0127	1.00632
LHMISCORE_0607_rev	17149	-3.76	13.95	-.0148	1.00604
LHMISCORE_0708_rev	17039	-4.87	13.56	-.0111	1.02282
Valid N (listwise)	16946				

Appendix Table 5: Correlations Among HMI Scores by Year (Low-Mod Tracts Only)

		LHMISCORE_0405_rev	LHMISCORE_0506_rev	LHMISCORE_0607_rev	LHMISCORE_0708_rev
LHMISCORE_0405_rev	Pearson Correlation	1	.912**	.816**	.771**
	Sig. (2-tailed)		.000	.000	.000
	N	17206	17145	17091	16987
LHMISCORE_0506_rev	Pearson Correlation	.912**	1	.921**	.807**
	Sig. (2-tailed)	.000		.000	.000
	N	17145	17186	17106	16977
LHMISCORE_0607_rev	Pearson Correlation	.816**	.921**	1	.903**
	Sig. (2-tailed)	.000	.000		.000
	N	17091	17106	17149	16996
LHMISCORE_0708_rev	Pearson Correlation	.771**	.807**	.903**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	16987	16977	16996	17039

**. Correlation is significant at the 0.01 level (2-tailed).